COT Aging Report

All Experimenters Meeting

June 14, 2004

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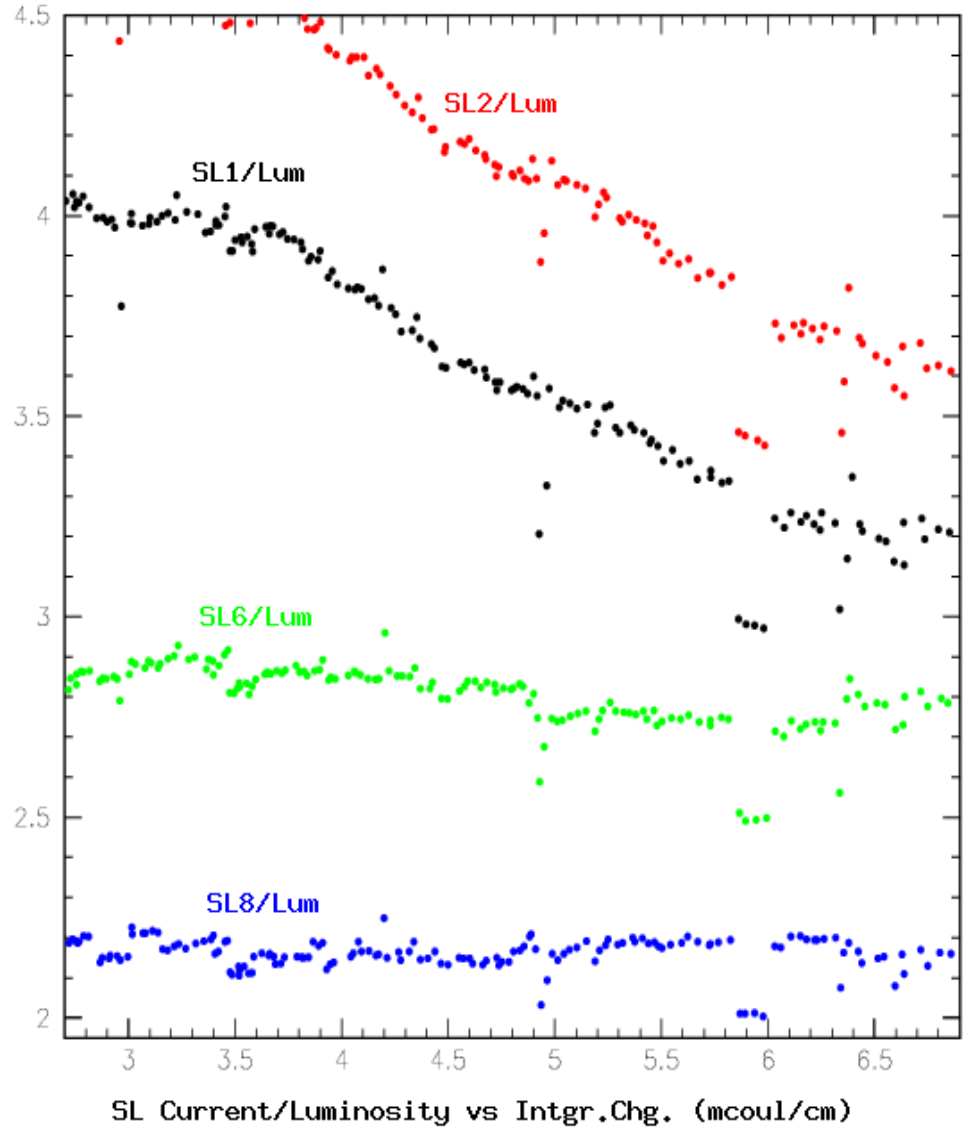
Basics of Aging in COT

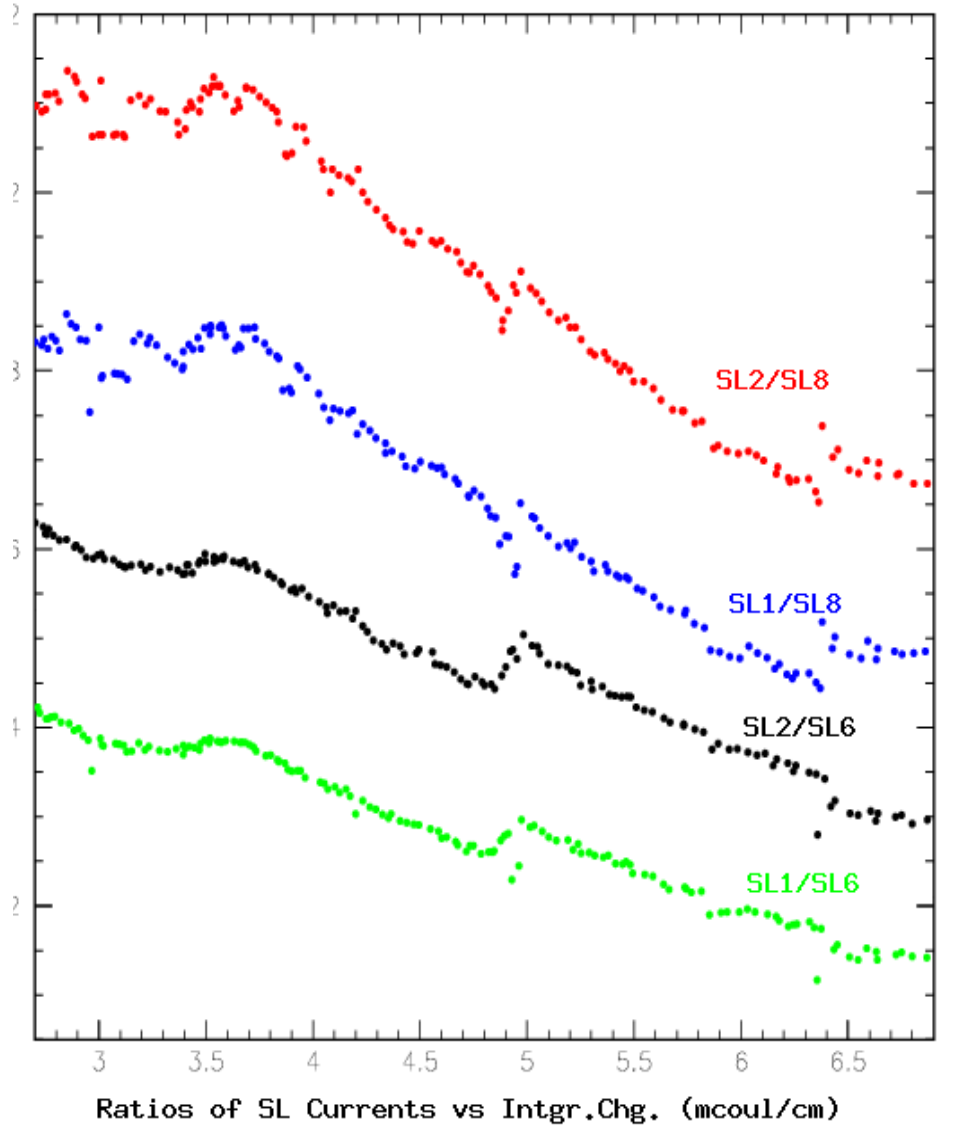
- Aging due to a coating on the sense wires.
- Analysis shows coating is mostly carbon and hydrogen with a little oxygen.
- Aging enhanced on exhaust side of COT.
- Presumably polymers (strings made of CH2 groups?) grow in gas. When the strings get long enough, they plate out on the sense wires.
- Probably deposition rate is very temperature sensitive (temperature also controls convection).
- Probably are competing processes when avalanches are present: ablation and deposition.

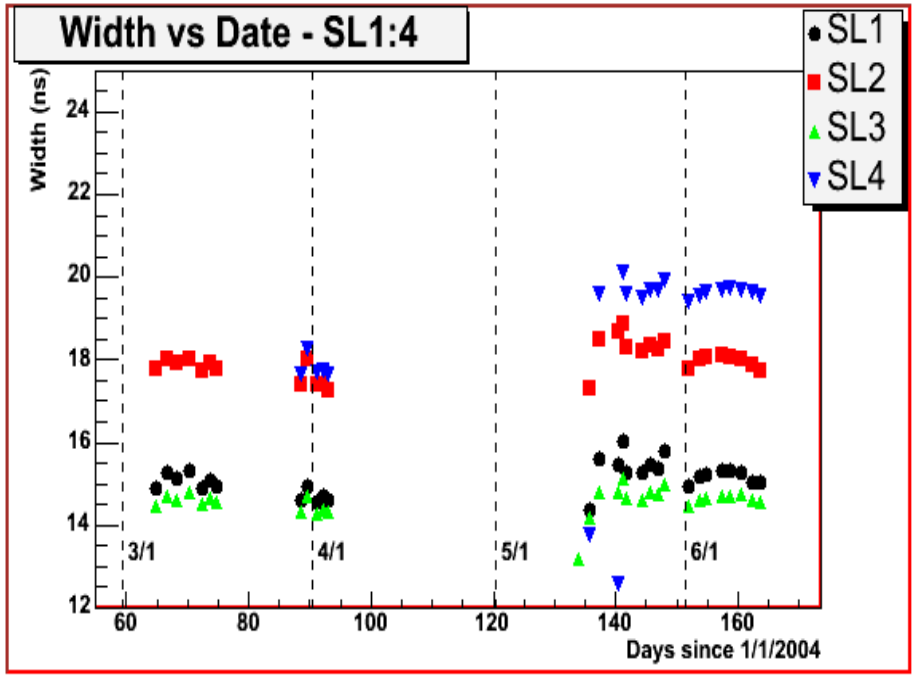
Recirculation added to increase gas flow to limit polymer buildup.

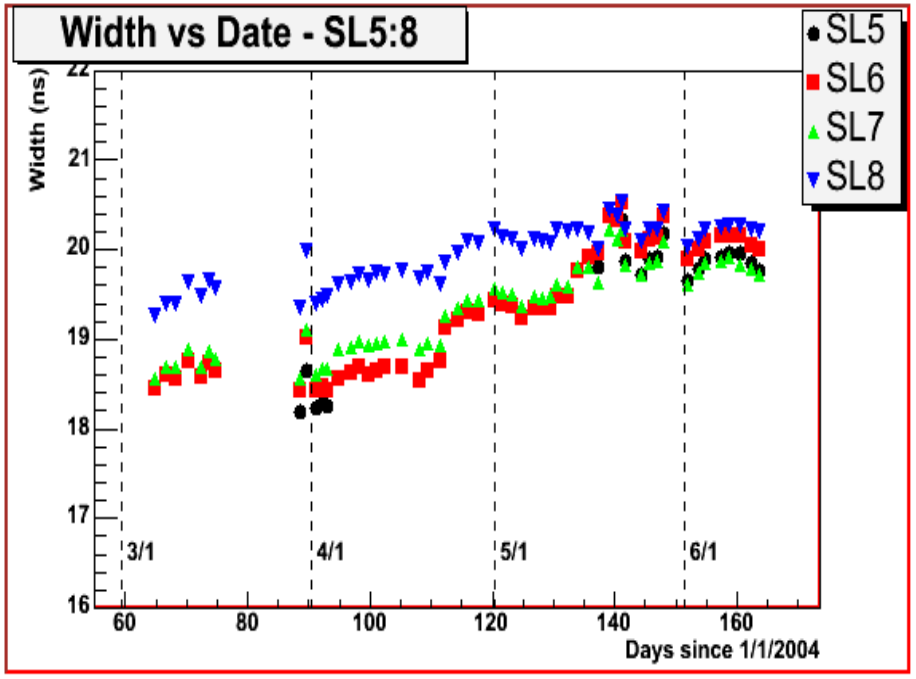
- Started on May 14, 2004, but problems with the pump limited the flow.
- Full 160-170 SCFH established May 24, 2004.
- Since May 14th we have accumulated about
  0.5 mC/cm on SL8 wires.
- Total Run2 accumulation on SL8 with HV on all Super-layers is about 6.9 mC/cm.
- Still not enough data to definitively measure aging with recirculation.
- Can monitor aging with currents and luminosity.
- Can monitor aging with widths of hits on tracks since widths are proportional to the charge in chamber pulses.

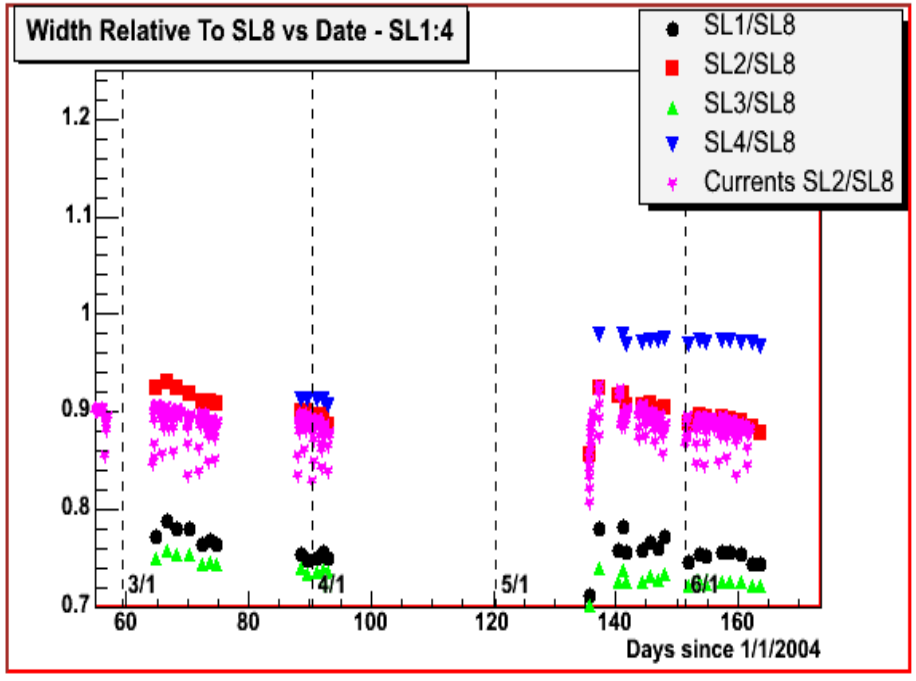
Cot Currents since April 2003

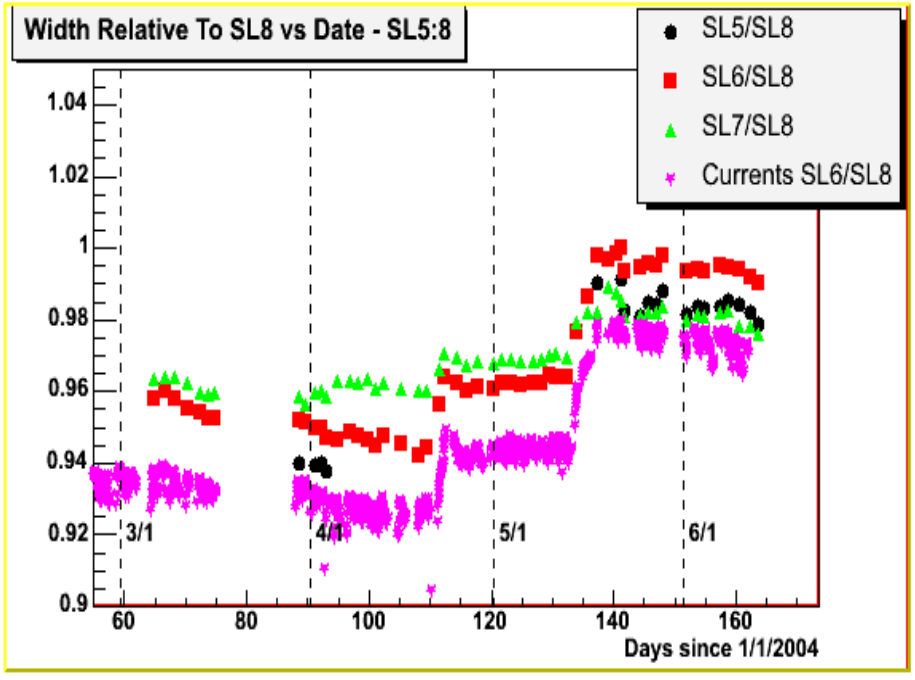





Width vs Date - SL1:4
SL1
SL2
SL3
SL4
Width (ns)
3/1
4/1
5/1
6/1
Days since 1/1/2004


Width vs Date - SL5:8
SL5
SL6
SL7
SL8
Width (ns)
3/1
4/1
5/1
6/1
Days since 1/1/2004


Width Relative To SL8 vs Date - SL1:4
SL1/SL8
SL2/SL8
SL3/SL8
SL4/SL8
Currents SL2/SL8
3/1
4/1
5/1
6/1
Days since 1/1/2004


Width Relative To SL8 vs Date - SL5:8
SL5/SL8
SL6/SL8
SL7/SL8
Currents SL6/SL8
3/1
4/1
5/1
6/1
Days since 1/1/2004

Can look COT currents on hourly basis

- Plots start after March shutdown and do not include first 6 hours of a store to reduce transient effects.
- First plot shows only currents for only those hours that inner super-layers are on:

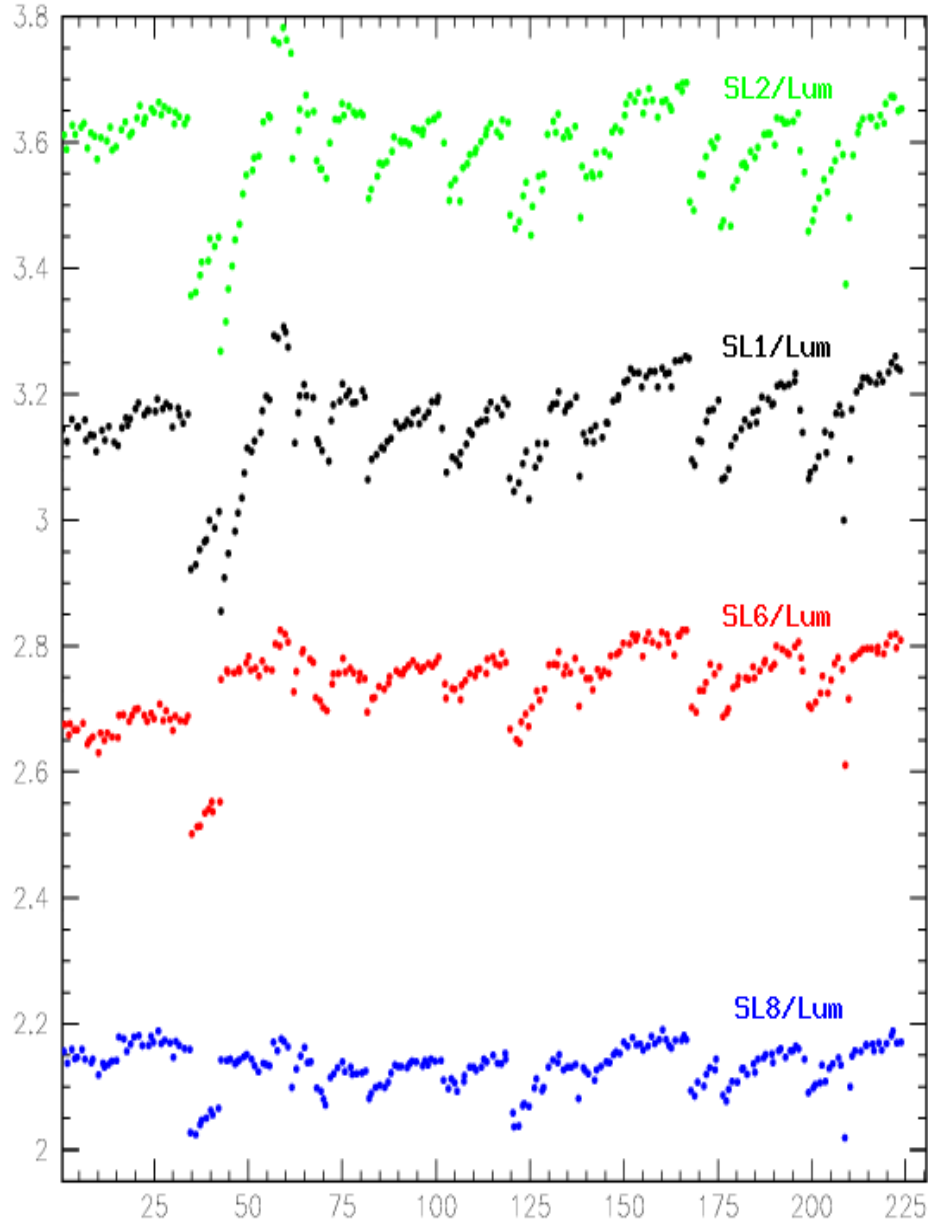
  Recirculation Starts May 14th (hour 42)

  Full Recirculation May 24th (hour 90)

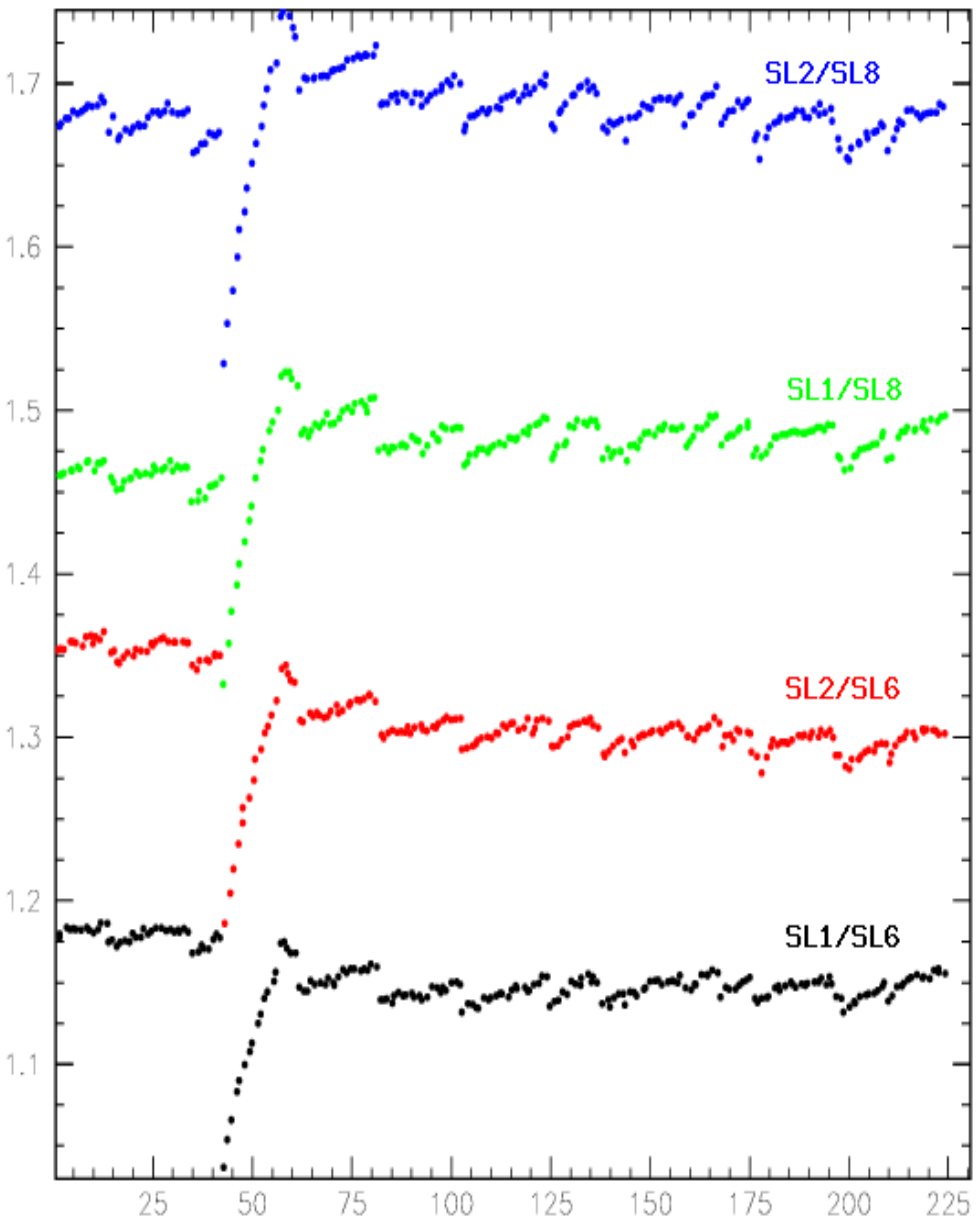
  Cosmic Ray run May 27th (hour 119)
- Second plot only for outer super-layers and includes hours when inner super-layers are off (April and first part of May):

  April 20th store with excess O2 (hour 181-189).

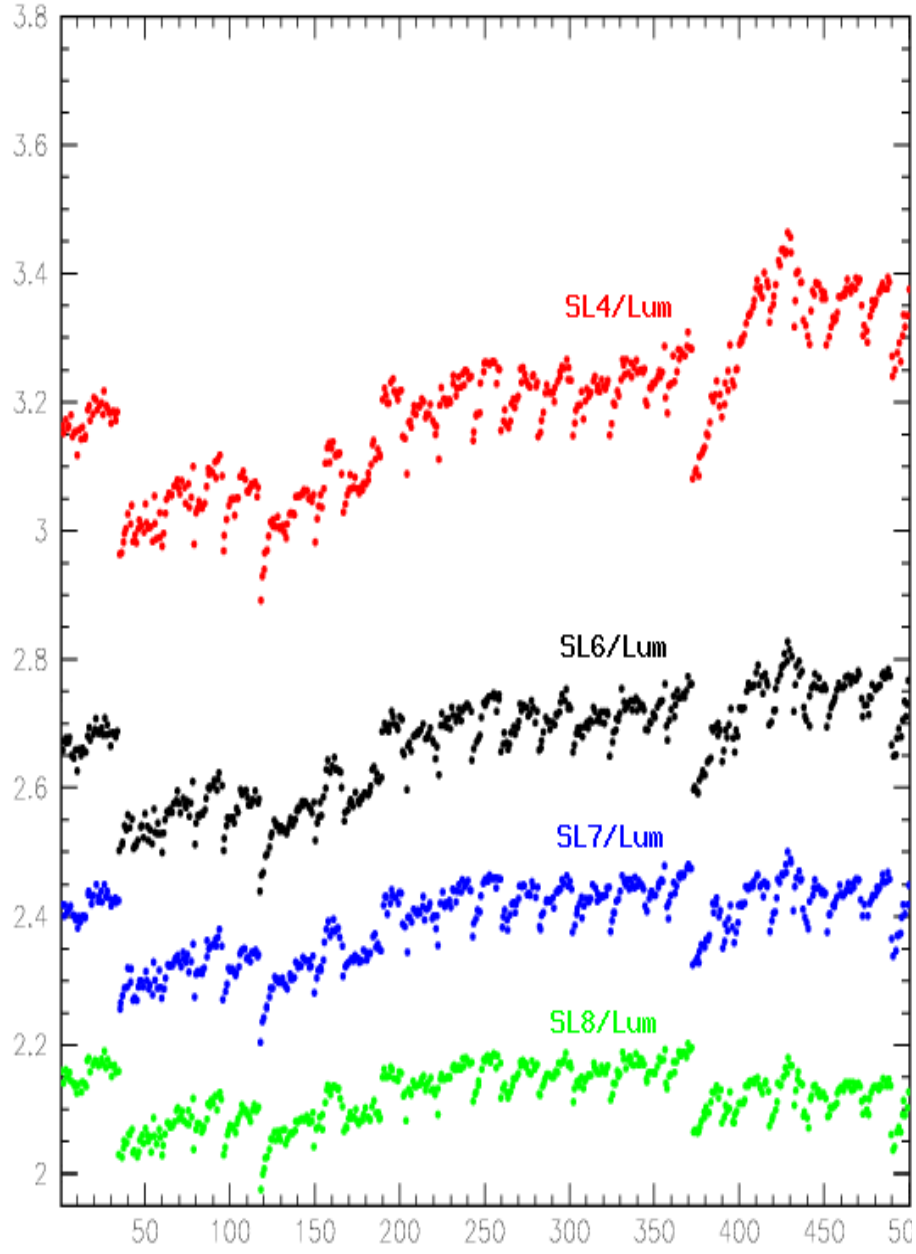
  Start of recirculation May 14 (hour 396) with excess O2 from hour 384-417.



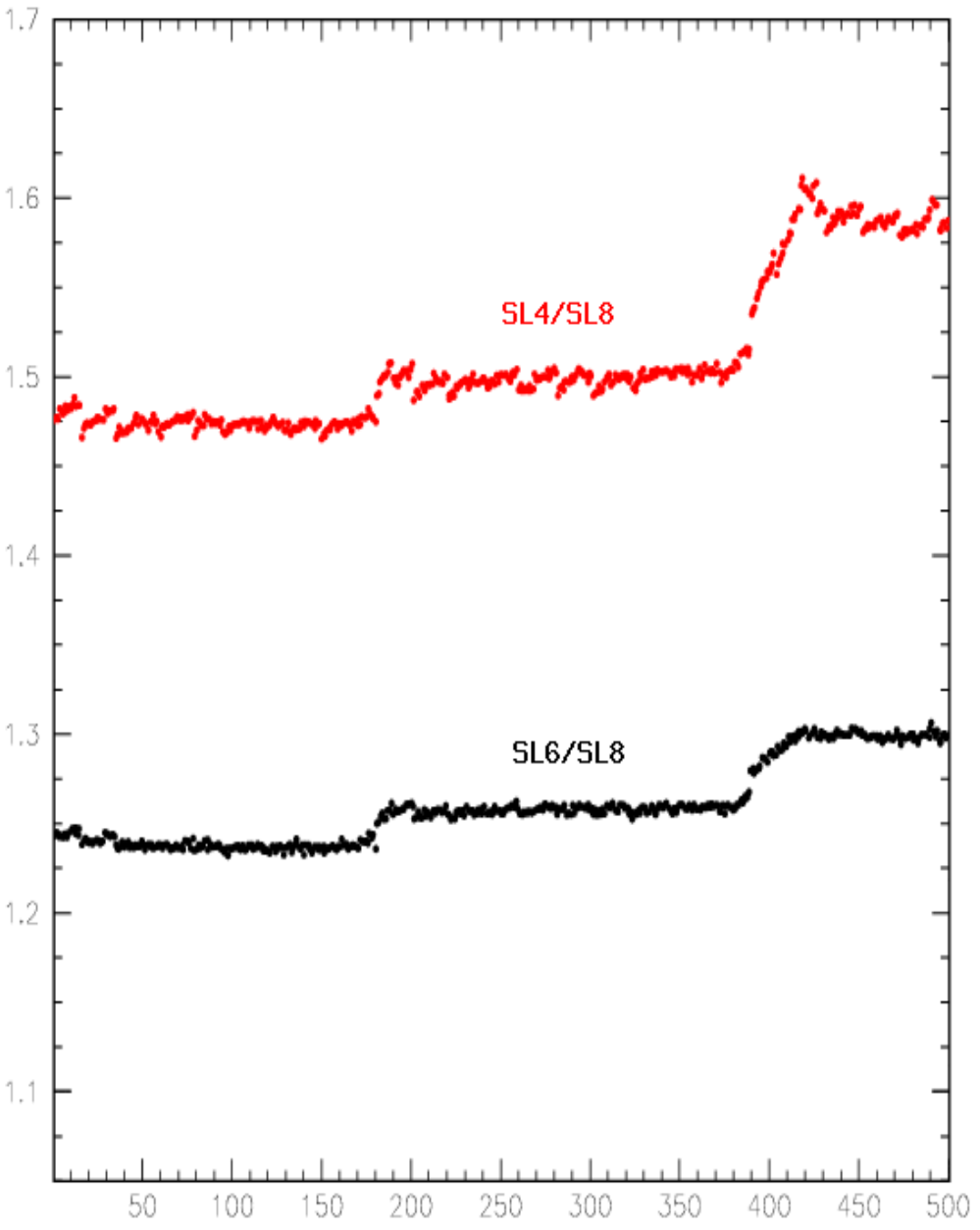
SL Current/Luminosity vs approx. hours HV on



SL Current Ratios vs approx hours HV on



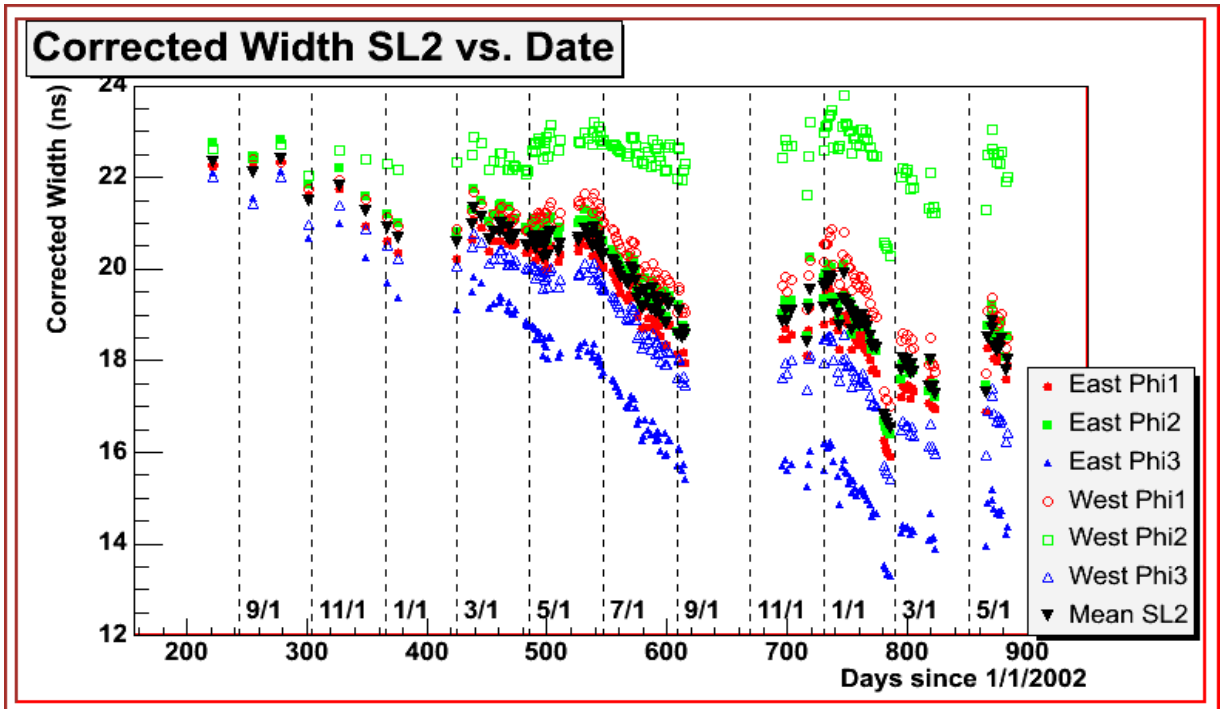
Outer SL Currents/Lum vs approx. hours HV on

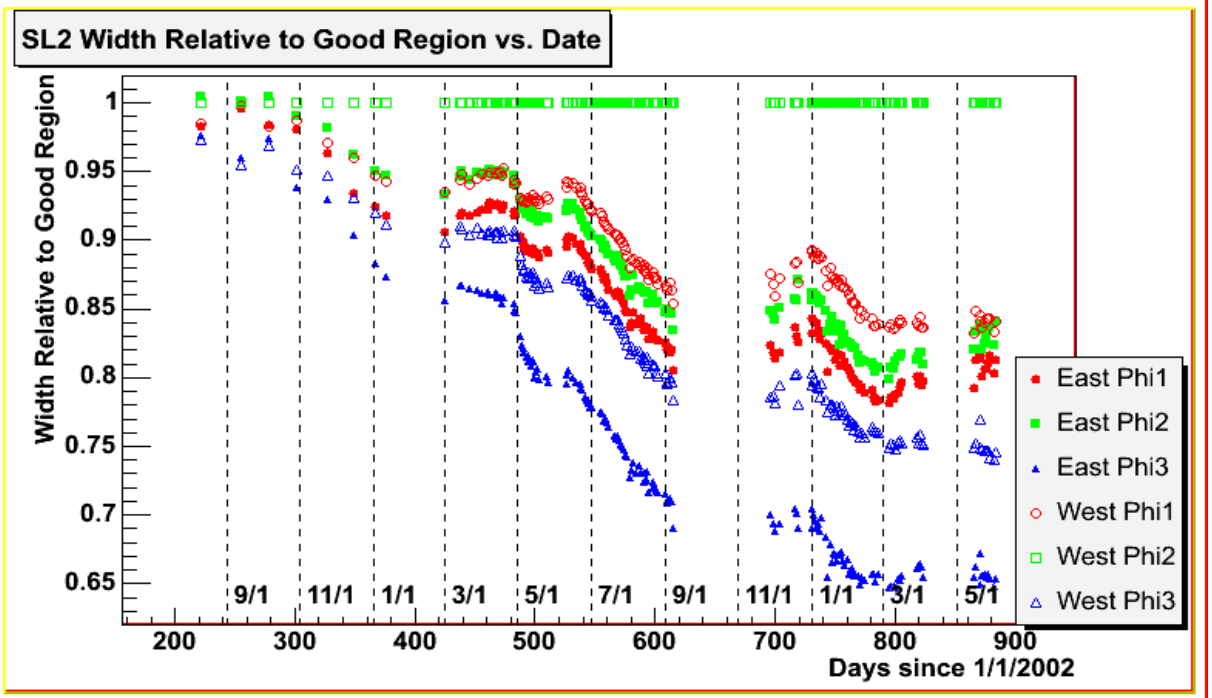


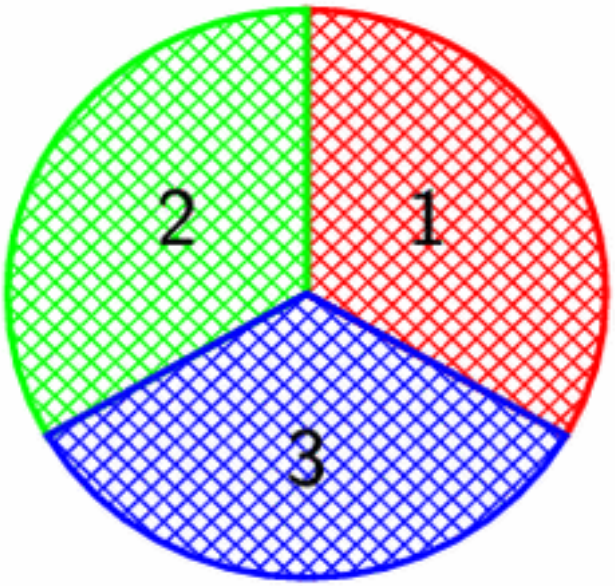
SL Current Ratios vs approx. hours HV on

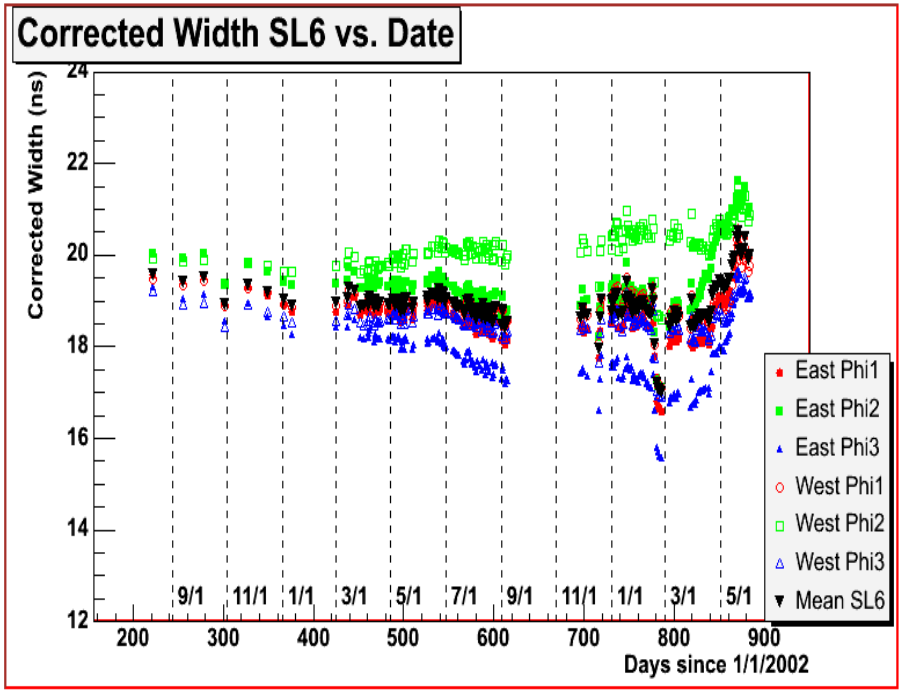
Can check aging vs location in COT using widths of hits on good tracks.

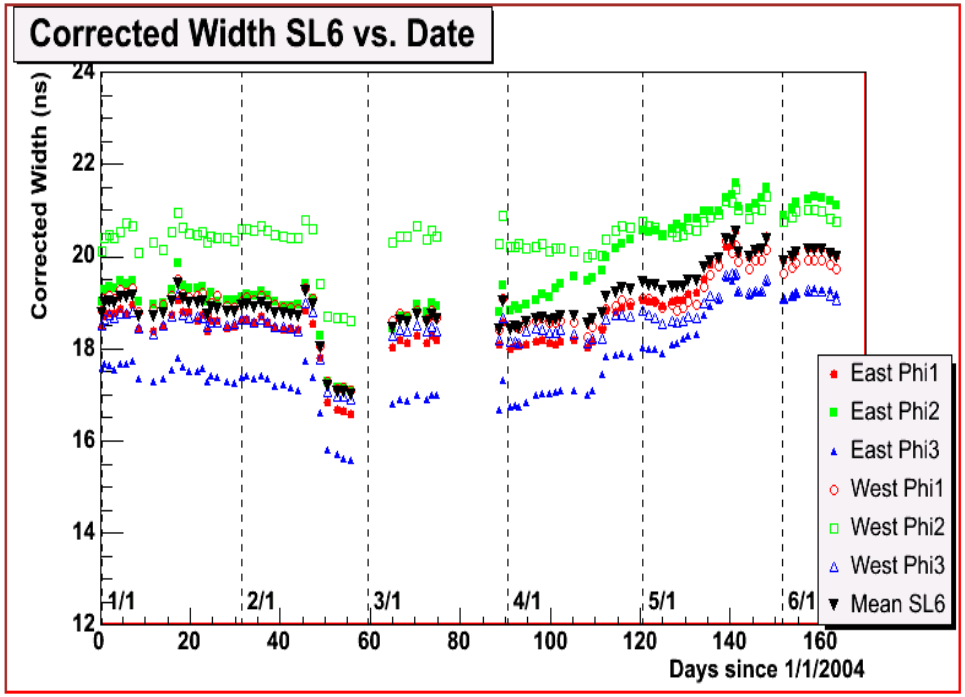
- Aging depends of gas flow direction. Flow was reversed March 2, 2004.
- Inner Super-layers off all of April and half of May which allows chance to observe low aging.
- Divide COT in to six regions: two in z and three in phi and examine widths (which are proportional to charge in the chamber pulse).
- Recall that flow originally west to east.
- After reversal, flow is east to west.
- Pick upper (Phi2) west as reference location.

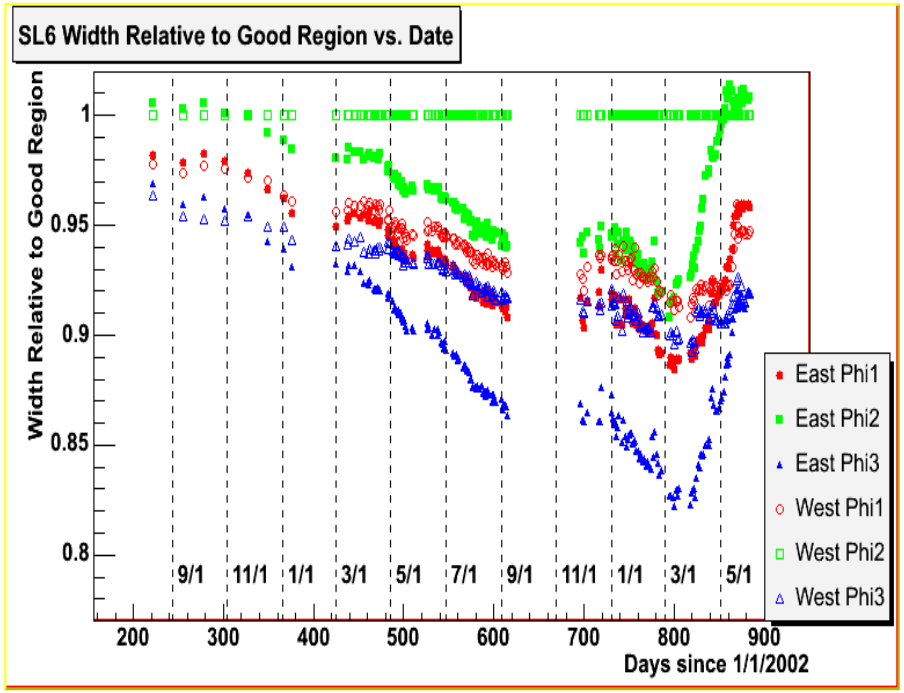

Corrected Width SL2 vs. Date
Corrected Width (ns)
24
22
20
18
16
14
12
9/1
11/1
1/1
3/1
5/1
7/1
9/1
11/1
1/1
3/1
5/1
200
300
400
500
600
700
800
900
Days since 1/1/2002
East Phi1
East Phi2
East Phi3
West Phi1
West Phi2
West Phi3
Mean SL2

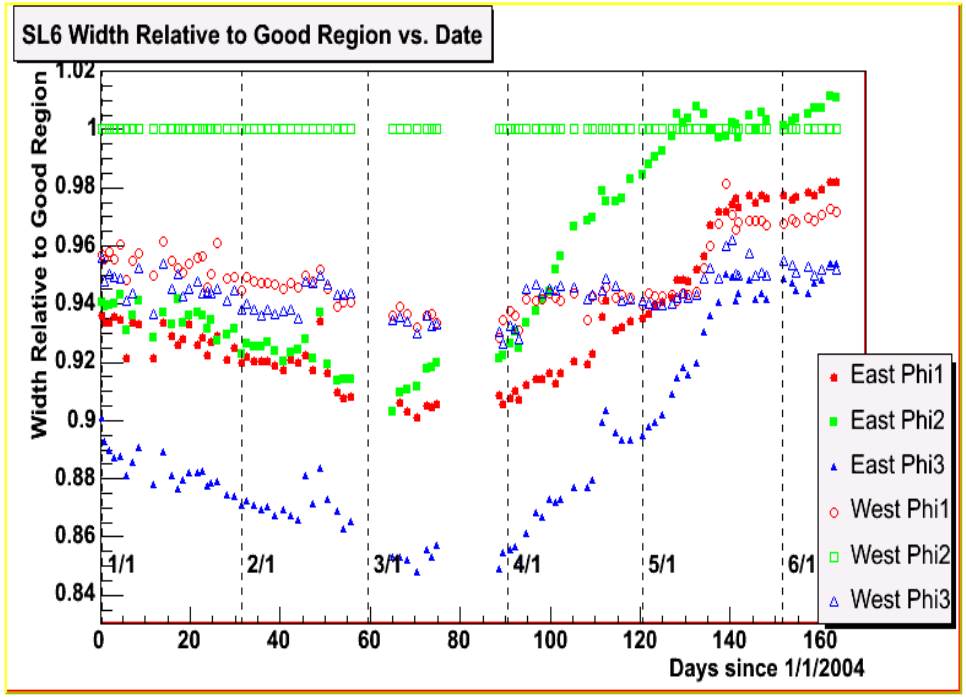

SL2 Width Relative to Good Region vs. Date
Width Relative to Good Region
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
9/1
11/1
1/1
3/1
5/1
7/1
9/1
11/1
1/1
3/1
5/1
200
300
400
500
600
700
800
900
Days since 1/1/2002
East Phi1
East Phi2
East Phi3
West Phi1
West Phi2
West Phi3


1
2
3


Corrected Width SL6 vs. Date
Corrected Width (ns)
Days since 1/1/2002
East Phi1
East Phi2
East Phi3
West Phi1
West Phi2
West Phi3
Mean SL6

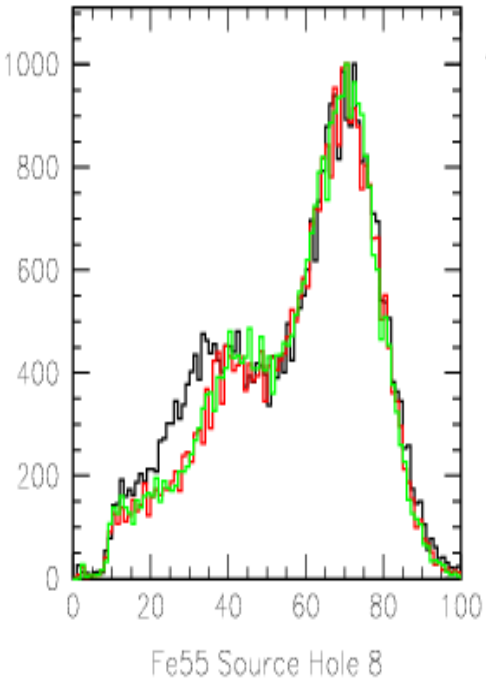

Corrected Width SL6 vs. Date
Corrected Width (ns)
Days since 1/1/2004
East Phi1
East Phi2
East Phi3
West Phi1
West Phi2
West Phi3
Mean SL6


SL6 Width Relative to Good Region vs. Date
Width Relative to Good Region
Days since 1/1/2002
East Phi1
East Phi2
East Phi3
West Phi1
West Phi2
West Phi3

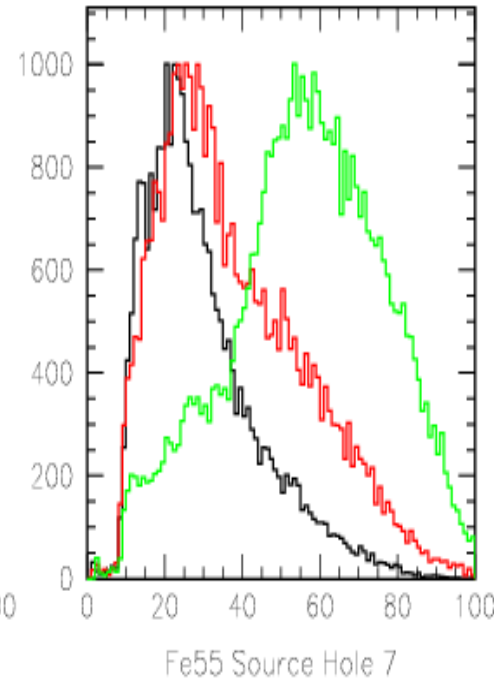

SL6 Width Relative to Good Region vs. Date
Width Relative to Good Region
Days since 1/1/2004
East Phi1
East Phi2
East Phi3
West Phi1
West Phi2
West Phi3

Tests of bad wire plane using GMC with Sr90 Source

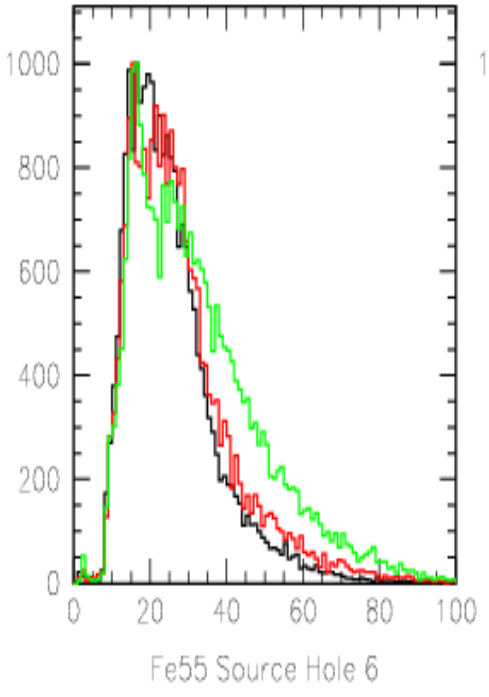
- Have tried with both Ar/Ethane/Alcohol and Ar/CO2 gases.
- See reverse aging with both gases.
- See currents in chamber increasing linearly with time indicating there is a steady ablation of coating.
- Use Fe55 spectra to measure gain vs position.
- With Ar/Ethane/Alcohol the aging is reversed directly under the source but rest of chamber still ages.
- With Ar/Co2 aging gets better everywhere.
- Following plot show effect of irradiating hole 7 of GMC. Black is before, red during, green after.



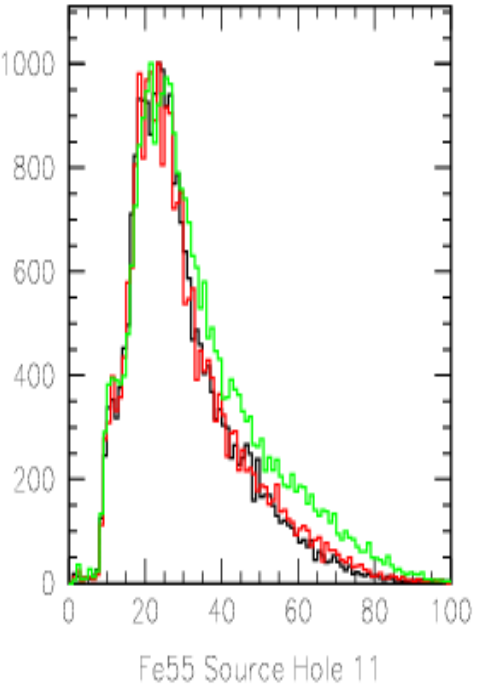
Fe55 Source Hole 8



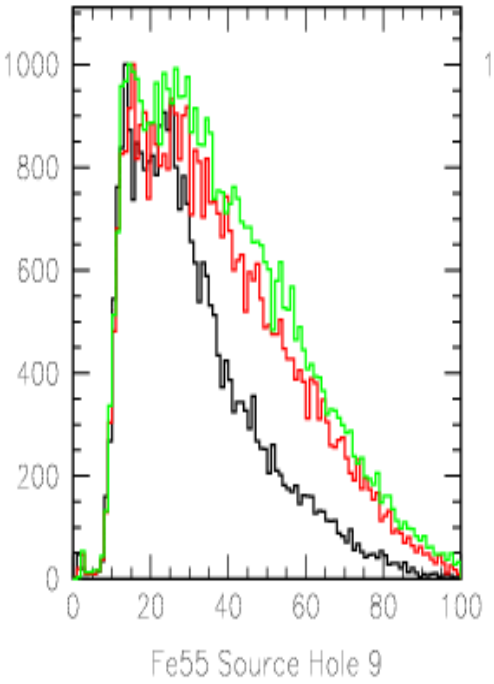
Fe55 Source Hole 7



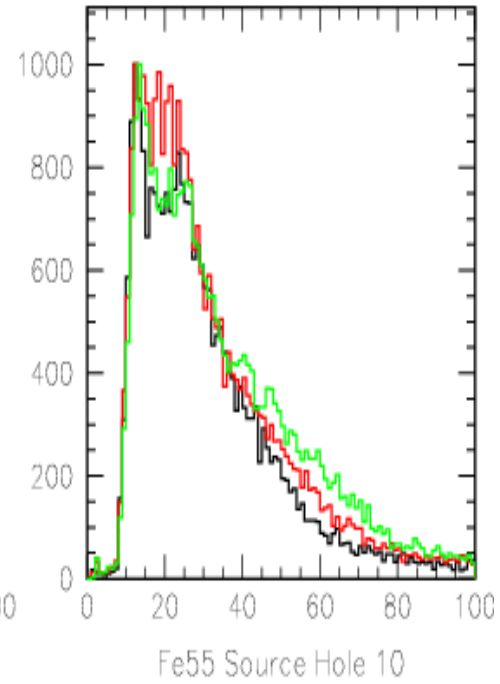
Fe55 Source Hole 6



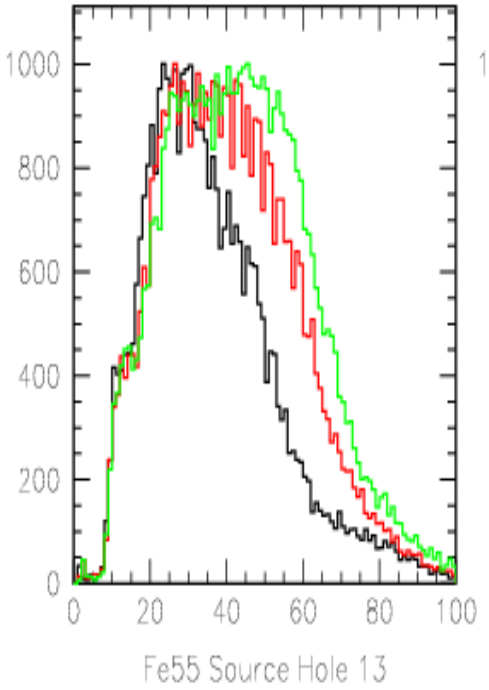
Fe55 Source Hole 11



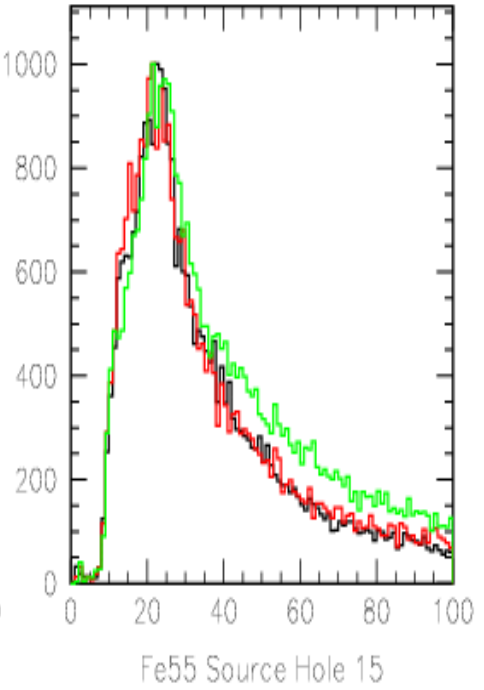
Fe55 Source Hole 9



Fe55 Source Hole 10



Fe55 Source Hole 13



Fe55 Source Hole 15

Conclusions

- Need more data, but aging probably improved with recirculation.
- Want to add O2. Hopefully this week.
- If O2 doesn't work will probably have two options:
  1) Try cleaning up the recirculated gas.
  2) Switch to Argon/CO2 based gas
- Information at following web sites:
  http://ncdf82.fnal.gov/~binkley/cot/aging/
  http://fcdfwww.fnal.gov/~burkett/COT/recent/